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(54) Title: RELEASING AGENT FOR DIE-CAST MOULDING PROCESSES OF NONFERROUS MATERIALS, COMPOSED OF A MIXTURE OF SYNTHETIC OILS AND BIODEGRADABLE VEGETAL FLUIDS

(57) Abstract: The present invention relates to a releasing agent composed of a mixture of synthetic oils and biodegradable vegetable fluids designed to be preferably used in die-cast moulding processes of non-ferrous materials.

Description

Releasing agent for die-cast moulding processes of nonferrous materials, composed of a mixture of synthetic oils and biodegradable vegetal fluids.

The present patent application for industrial invention relates to a releasing agent composed of a mixture of synthetic oils and biodegradable vegetable fluids designed to be preferably used in die-cast moulding processes of non-ferrous materials.

In any case the substance of the invention can be advantageously used also for rolling, extrusion or hot-drawing processes and in any other type of moulding process where adherence between mould and moulding material must be avoided.

These processes require the use of the so-called "lubro-releasing" substances, which consist in a fluid, paste or solid placed between mould and part to make metal slide better during the moulding process and avoid the adhesion between part and mould, in order to obtain better finished parts and at the same time extend the life of the mould.

To better appreciate the advantages of the releasing agent of the invention the description continues with a presentation of the releasing agents that are currently used, with relevant disadvantages.

The first group is represented by water-dilutable releasing agents, which can be grouped into three main classes:

a) water graphite dispersions;

b) water solutions;

c) water emulsions.

The active principle is the same for the three different classes of products: the lubro-releasing agent is usually sprayed on the mould. A film of the active substance is obtained further to water evaporation, ensuring

lubrication and release functions.

The products that are currently available on the market are normally composed of a concentrated substance that must be diluted with water in the correct proportion.

In particular, water/oil graphite dispersions are composed of:

- graphite in fine particles (in some cases most of the particles have dimensions lower than 1 micron),
- dispersion "stabilising" agent, often organic or inorganic salt, to favour the creation of a strong film on the mould,
- different additives, such as bactericides, viscosity stabilisers, anti-mould, etc.

The graphite contained in the currently available products is either of natural or synthetic type. The performance of the products is basically determined by the purity and fineness degree of the particles (apart from the synergetic action of the other components).

The use of bactericides is very important, since the degradation caused by bacteria in water graphite dispersions could cause demulsibility, with separation and decantation of graphite in water, apart from the known inconveniences represented by unpleasant smell and irritation for operators.

Modern biocidal products and anti-mould substances contain no free formaldehyde and do not represent a potential danger for operators and environment.

The stability over time of water graphite dispersions guarantees the homogeneity of the elements contained in the formulation. Some water soluble polymers with high molecular weight contribute to maintain the fine dispersion of graphite in water with constant viscosity.

Water solutions are composed of:

- inorganic or organic salts,
- cellulose derivatives,
- high molecular weight polymers.

The correct combination of the components allows to obtain the film

with releasing, and at least partly lubricating, properties during moulding.

Chlorides, phosphates, silicates and some carboxylic acid salts are among the salts used.

High molecular weight polymers can be represented by synthetic ethoxylated alcohols, polycondensated compounds with ethylene oxide, etc.

Also in this case it is important to protect the solutions against the attack of bacteria with the aforementioned agents.

Water-soluble products can be introduced in the formulation to give anti-corrosion and anti-rust properties to the diluted ready-to-use product.

The use of nitrites is not recommended, since they can lead to the formation of dangerous complexes, such as nitrosamins.

It must be noted that in many metallurgic processes of complex nature water solutions are becoming more and more popular in replacement of graphite dispersions, being preferred by operators, since they are not black and they do not cause indelible stains on working apparel.

Finally, water emulsions that are particularly used in die-casting processes of light alloys are composed of:

- natural and synthetic wax derivatives
- mineral oils,
- silicone derivatives
- anionic/non-ionic (mainly non-ionic) emulsifiers that, having surfactant properties, reduce the surface tension between wax or oil phase and water, making the formation of fine dispersion of the wax and oil phases in water possible.

A milky-white emulsion or emulsions that tend to acquire the aspect and physical properties of solutions is obtained.

According to the chemical composition, the emulsifier can also act as lubricant, thus improving the performance of the emulsion.

The mostly commonly used emulsifiers are sulfonates (with ion-active charge) and, most of all, derivatives of condensations with ethylene oxide (with non-ionic charge).

The presence of derivatives with medium molecular weight in the emulsions reduces the tendency to the formation of rust and corrosion of ready-to-use products, obtained by diluting emulsions in 1-2% water concentrations.

The aforementioned emulsions are a very fertile ground for the proliferation of bacteria and it is therefore necessary to introduce suitable bactericides and fungicides in the formulation to eliminate putrescence and demulsibility.

The mixture applied on the mould generally contains very low percentages of active matter (around 0.5%); this contraction has revolutionised some of the aspects of the die-casting process of light alloys, thus improving environmental conditions and performing the very important function of efficient cooling of the mould, thanks to the large amount of water contained in ready-to-use products.

The second category is represented by powder releasing agents, which are mainly composed of polymers with high molecular weight (polyethylene wax) with different melting point according to production requirements.

The same bases with graphite and/or talcum percentage are used for temperatures higher than standard (about 240^0C), providing thermal resistance to the product.

This description continues with the illustration of the disadvantages of each type of releasing agent as described above.

As regards water graphite dispersions, it must be said that they have been completely replaced by emulsions, due to the following problems:

- graphite dirt and environmental dispersion;
- need to use large ventilation systems in the moulding area to avoid the inhalation of graphite particles by operators;
- disposal of eluates, whose purification is not easy, due to the presence of graphite stains;
- instability of the dispersion, which must be continuously agitated in

order not to prejudice the active principle;

- poor quality of moulded parts, which are very dark and matt, with significant inclusions and ashes, resulting in bad esthetical defects;
- periodical cleaning of moulds, with consequent interruption of the production cycle.

On the other hand, it must be said that water emulsions have their own disadvantages, especially in terms of water and air contamination.

The emulsion sprayed on the mould falls at the base of the machine and the extra amount of product is removed through pipes, but cannot be disposed of in public sewerage because it is highly polluting.

Waste waters are usually disposed of by specialised companies, or subjected to chemical-physical treatments, ultrafiltration or evaporation, and, in general, very expensive purification treatments that generate mud and dirt that need to be disposed of.

Moreover, unpleasant smells are generated in the moulding departments because of the deterioration of recovered eluates.

In view of the large amount of releasing agent sprayed on the mould (normally from 2 to 5 times the necessary amount, according to nozzle and type of mould), a good part of the extra amount of product falls on the floor, as mentioned earlier, while the rest is converted into vapour and dispersed in the environment.

For environmental protection reasons, foundries must be equipped with suitable installation to capture and filtrate oil fogs, of which a small part is dispersed in the atmosphere and produce considerable oil particles in the filters.

Another problem is represented by the temporary stability of the products. Normally, emulsion manufacturers indicate 6 to 12 months as degradation time, in optimal conditions and closed environment with minimum and maximum temperatures of 3°C and 10°C.

The use of emulsions involves the following disadvantages during the production process:

- need to increase the mould temperature above 100°C to allow for evaporation of the water part of the releasing agent;
- considerable thermal shock of the mould, due to the fact that by evaporating at 100°C, the water phase causes a thermal increase on the hot surface of the mould, normally 240-280°C, thus creating considerable thermal stress and impairing the duration of the mould;
- corrosion of the mould and of the various components of the machine that are exposed to continuous contact with releasing vapours;
- development of gas and vapours;
- formation of waste due to gases and vapours deriving from the contact between the releasing film and the liquid metal, which generate blowholes in die-cast parts;
- carbon deposits or other sediments due to the accumulation of the releasing film, in relatively cold areas of the mould;
- poor brightness of parts due to the presence of salts in water.

As regards powder releasing agents, it must be said that they are especially impaired by difficult application, as explained below.

This type of releasing agents is applied on the mould with special electrostatic guns.

The product must be prepared and studied according to the type of use, in consideration of the small temperature margin of these products.

In case of high temperatures of the mould, the product is converted into ashes, thus losing its releasing properties and result in metalization effect. In case of temperatures lower than use temperatures, overdeposition phenomena are produced, causing the non-closure of the moulds.

Due to the lack of water as cooling vehicle, cooling problems of the moulds originate, considerably extending the duration of the moulding cycle, because the moulding material needs time to solidify.

On the other hand, the life of the moulds is extended, in view of the low thermal shocks to which they are subjected.

The purpose of the invention is to realise a new releasing agent for

moulding processes in general, which is not impaired by the disadvantages illustrated above for the releasing products that are currently available and used.

This purpose has been achieved by the releasing agent of the invention, which is mainly composed of synthetic oils and biodegradable vegetal fluids.

This substance is very versatile from the temperature viewpoint, with a range of use from 80°C to 320°C.

Compared to water solutions, the formulation contains no emulsifiers, anti-bactericides, synthetic waxes and special additives that are used to make solutions stable, resulting in a lower amount of residuals.

Unlike powder releasing agents, the substance of the invention can be used together with cooling water sprays for the correct thermal regulation of the mould, thanks to the fact that the substance is not soluble in water, although compatible with it.

It can be advantageously stated that the substance of the invention has all the positive qualities of the other releasing agents, and at the same time solves all the aforementioned problems regarding the management of the moulding process and the environmental impact.

More precisely, the substance of the invention consists in a mixture composed of:

a) Modified silicone oil with medium viscosity;
b) Biodegradable organic ester derived from synthesis process.

According to the specific case and requirements, the mixture can also contain:

c) Silicone oil with low molecular weight (dimethyl polysiloxane)
d) Pine oil

The component (a) is a silicone oil with medium viscosity (900/1500 cst at 25° C), which has excellent releasing properties even in very small quantities.

The silicone oil is very stable at high temperatures up to 280° C and

therefore it does not decompose in contact with the hot surface of the mould, thus avoiding the formation of carbon residuals.

The component (b) is a biodegradable synthetic oil with viscosity equal to 46 cst at 40°C, which has good anti-oxidising, anti-wear and releasing properties. The biodegradable synthetic oil resists to fire and temperature up to 200° C.

The mixture of the invention must have the following characteristics:

- Viscosity at 25° C from 140 and 200 cst;
- Flash point from 100° and 260° C;
- Thermal resistance higher than 250° C.

It must be noted that the addition of the component (b) to the component (a) aims to reduce the viscosity of the mixture without significantly reducing its flash point.

The component (c) is a silicone oil with viscosity equal to 4 cst at 25° C, which has good lubricating properties.

When necessary, the component (c) is used as diluent to manage the final viscosity of the mixture better.

In other words, the addition of the component (c) allows to obtain a mixture with the desired viscosity, using a lower percentage of the component (b), since the viscosity of the component (c) is much lower than the viscosity of the component (b).

On the other hand, the use of the component (c) does not impair the releasing properties of the mixture, since the same component (c) has good lubricating properties.

Finally, the component (d) is added to the mixture for aromatic purposes.

It must be noted that three substances with the characteristics of the components (a), (b) and (c) are already available on the market.

In particular, the following substances can be used as components (a) (b) and (c), respectively:

A) Modified silicone oil marketed by WACHER with the name TN;

B) Biodegradable organic ester marketed by IP with the name IP HYDRUS BIO FR Estere 46;

C) Silicone oil marketed by WACHER with the name WACHER SILICONO Z 040.

These components must be mixed in correct proportions based on the complexity and the structure of the part to be moulded.

Following are some examples.

EXAMPLE 1

The following composition is recommended for complex parts requiring high releasing effect:

a) 54% in weight of modified silicone oil, of the type marketed by Wacher with the name TN;

b) 8.5 % in weight of biodegradable organic ester with viscosity equal to 46 cst at 40°C;

c) 37% in weight of silicone oil with low molecular weight, of the type marketed by Wacher with the name WACHER SILICONO Z 040:

d) 0.5% pine oil.

The characteristics of the aforementioned mixture are as follows:

- Viscosity at 25° C: 147, 4 cst;
- Flash point: 109°C;
- Thermal resistance higher than 250° C.

EXAMPLE 2

For medium-complex parts:

a) 40% in weight of modified silicone oil, of the type marketed by Wacher with the name TN;

b) 40 % in weight of biodegradable organic ester with viscosity equal to 46 cst at 40°C;

c) 19.5% in weight of silicone oil with low molecular weight, of the type marketed by Wacher with the name WACHER SILICONO Z 040:

d) 0.5% pine oil.

The characteristics of the aforementioned mixture are as follows:

- Viscosity at 25° C: 145,017 cst;
- Flash point: 220°C;
- Thermal resistance higher than 250° C.

EXAMPLE 3

For simple parts:

a) 30% in weight of modified silicone oil, of the type marketed by Wacher with the name TN;

b) 60 % in weight of biodegradable organic ester with viscosity equal to 46 cst at 40°C;

c) 9.5% in weight of silicone oil with low molecular weight, of the type marketed by Wacher with the name WACHER SILICONO Z 040;

d) 0.5% pine oil.

The characteristics of the aforementioned mixture are as follows:

- Viscosity at 25° C: 144,54 cst;
- Flash point: 240°C;
- Thermal resistance higher than 250° C.

As regards the preparation method of the substance of the invention, it must be said that the components are mixed at room temperature with a mechanical agitator with variable speed for homogenisation of the components, which must be preferably, but not necessarily, introduced in the container in the following order:

component c)

component b)

component a)

component d)

The agitator speed must be preferably, but not necessarily, programmed as follows:

for approximately the first five minutes: 150 revolutions per minute

for approximately additional 20 minutes: 300 revolutions per minute.

The description continues with the illustration of the advantages and qualities of the substance of the invention.

First of all, it must be noted that the substance of the invention is ready for use and does not need any additives, mixing installations or centralised distribution installations.

Additionally, no water contamination is produced, since the substance is sprayed directly on the mould. Should water be sprayed on the mould for cooling reasons, no water contamination originates, since the substance is not soluble in water. For this reason, the substance can be disposed of in sewerage with no risk of contamination and in any case filtered and reused.

The use of the substance of the invention does not result in atmospheric contamination, since quantities are very small (4 g/m^2 of product) and the ashes generated in the environment can be neglected, with consequent reduction in the capacity of the systems used to capture and aspirate fogs as set forth by the law.

Unlike other releasing products, the vapours of the substance of the invention do not generate corrosion on moulds or machine parts.

The substance of the invention generates a limited amount of gas or vapours when it comes into contact with the metal surface of the mould, thus resulting in uniform and compact moulded parts.

If the substance of the invention is formulated with the correct dose, the generation of residuals is practically absent.

The parts that are moulded with the substance of the invention are bright, thanks to the fact that they do not contain any water, which generates temperature variations on the mould.

The use of the substance of the invention allows to reduce the thermal shock of the moulds compared to currently used emulsions, in which the water component evaporates at 100^0C, with high thermal shock for the moulds at every cycle, passing from the water evaporation temperature to the metal injection temperature.

On the contrary, with the substance of the invention, it is possible to use water used for surface cooling only when necessary, using, for example, a probe on the mould to spray water when the set temperature value is

exceeded.

Claims

1) Releasing agent for moulding processes, characterised by the fact that it consists in a mixture formed by the following components:

a) Silicone oil with medium viscosity

b) Biodegradable organic ester derived from the synthesis process with viscosity equal to 46 cst at 40°C

in which:

- the component (a) is a silicone oil with medium viscosity (900/1500 cst at 25° C), very stable at high temperatures, up to 280° C;
- the component (b) is a biodegradable synthetic oil that resists to temperatures up to 200° C;

it being provided that the mixture has the following values:

- Viscosity at 25° C from 140 to 200 cst;
- Flash point from 100° to 260° C;
- Thermal resistance higher than 250° C.

2) Releasing agent for moulding processes according to the previous claim, characterised by the fact that it includes a third component (c) as diluent, which consists in a silicone oil with low molecular weight (dimethyl polysiloxane), with viscosity equal to 4 cst at 25° C and good lubricating properties.

3) Releasing agent for moulding processes according to the previous claims, characterised by the fact that it includes a fourth component (d) with aromatic functions, consisting in pine oil.

4) Releasing agent for moulding processes according to claims 1 to 3, in which the components (a) (b) and (c) are respectively:

A – the modified silicone oil marketed by WACHER with the name TN;

B – the biodegradable organic ester marketed by IP with the name IP HYDRUS BIO FR Estere 46;

C – the silicone oil marketed by WACHER with the name WACHER SILICONO Z 040.

5) Releasing agent for hot-moulding processes according to the previous claims, characterised by the fact that it has the following formulation:

a) 54% in weight of modified silicone oil, of the type marketed by Wacher with the name TN;

b) 8.5 % in weight of biodegradable organic ester with viscosity equal to 46 cst at 40°C;

c) 37% in weight of silicone oil with low molecular weight, of the type marketed by Wacher with the name WACHER SILICONO Z 040:

d) 0.5% pine oil.

6) Releasing agent for hot-moulding processes according to claims 1 to 4, characterised by the fact that it has the following formulation:

a) 40% in weight of modified silicone oil, of the type marketed by Wacher with the name TN;

b) 40 % in weight of biodegradable organic ester with viscosity equal to 46 cst at 40°C;

c) 19.5% in weight of silicone oil with low molecular weight, of the type marketed by Wacher with the name WACHER SILICONO Z 040:

d) 0.5% pine oil.

7) Releasing agent for hot-moulding processes according to claims 1 to 4, characterised by the fact that it has the following formulation:

a) 30% in weight of modified silicone oil, of the type marketed by Wacher in with the name TN;

b) 60 % weight of biodegradable organic ester with viscosity equal to 46 cst at 40°C

c) 9.5 % in weight of silicone oil with low molecular weight, of the type marketed by Wacher with the name Z 040

d) 0,5 pine oil.